

SUGGESTIONS FOR OBSERVATIONS

ON THE INFLUENCE OF

CHOLERA AND OTHER EPIDEMIC POISONS,

ON

THE LOWER ANIMALS.



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INFLUENCE OF CHOLERA AND EPIDEMIC POISONS

ON

THE LOWER ANIMALS.

NO one at all conversant with the literature of cholera in this country can fail to have observed, that an immense amount of labour has been expended in investigating the natural history of the disease, since its first invasion in 1832, without adequate results. If we place in one scale of the balance, the thousands of volumes, pamphlets, and papers that have been written, and in the other, the actual amount of knowledge which we at present possess, the result cannot be but most unsatisfactory—most humiliating. The causes of this have been manifold, but to only two of them need I here allude. The attention of observers appears to have been too much concentrated on particular points in the natural history of cholera—for instance, on its empiric treatment; and, as a consequence, certain paths of research may be said to have been trodden bare, while others have been comparatively unexplored. Of the latter, one of the most important, undoubtedly, is the influence of the cholera poison on plants and the lower animals, whether communicated naturally or artificially. Again, there has been too frequently evinced a premature anxiety to attain general results, to deduce general laws or principles, to jump at general conclusions. This tendency is too often fatal to the interests of true science; it leads us to ignore, distort, or misinterpret *facts*. The results of investigations entered upon in this spirit have always proved the full force and truth of the trite sayings, that “facts are stubborn things,” for they can neither with impunity be ignored nor distorted; and that there are “more false facts than false theories in medicine.” It seldom happens—nay, it is scarcely reasonable to expect—that the same mind is equally fitted, on the one hand, accurately to observe, and laboriously to accumulate facts; and on the other, to sift, arrange, and reason upon these, so as to deduce general principles. No; he who gathers the harvest of facts into the storehouses of knowledge is the type of one class of naturalists—the careful, plodding, unostentatious ob-

server—he may be said to be actuated by a spirit of acquisitiveness ; while he who subjects the grain thus accumulated to the machinery of mental and scientific analysis—who separates the wheat from the chaff—who, from a chaos of apparently unconnected data, evolves harmonious laws, and exhibits their mutual relations and significations—is the type of an opposite class, whose labours are guided by the spirit of inductive philosophy. So far as regards the investigation of the natural history of cholera, I fear we must meanwhile be content to belong to the first class above enumerated—the class of observers, and gather into our public journals and learned societies a mass of simple facts, bearing on various points, which as yet are very obscure, or have not been properly elucidated. For, with Dr Gull, I believe firmly that, “for the present, such generalizations are of little value, and that we arrest inquiry by their adoption.” Let us take a somewhat parallel example. Look at the science of meteorology, now comparatively so perfect ; or let us consider, in particular, the laws of the winds and waves—of marine and aerial currents. On how many thousands of observations, noted in every part of the habitable globe for a long series of years, is our interpretation of these laws founded ? The logs of the world’s navies contain the facts simply noted by myriads of observers, who had no fore-shadows of the important general principles which they were contributing, in however great or small a degree, to evolve or deduce—observers comparatively uneducated, and who had little idea of the possible practical applications of science to their own art—the art of navigation. But from piles of apparently worthless log-books, a Maury is able to deduce the most beautiful general laws, to interpret nature with the highest practical benefits. In the investigation of such a subject as that of cholera, we cannot each one expect to be a Maury, to be the means of solving the Gordian problem of the essential nature and cause of cholera ; but every observer may add a fact, or many facts, to the general fund of positive knowledge, and until such a fund is vast and valuable, a Maury’s labours are useless and out of place.

I have spoken of the voluminous nature of the literature of cholera in this country, and of the undue attention devoted to particular branches of its natural history, with the entire neglect of others. The record of illustrations of the influence of the cholera poison on plants and the lower animals, is extremely meagre and unsatisfactory. This subject appears to me to have a most important bearing on the advancement of our knowledge of cholera in man ; and a conviction of the fertile and valuable results which this field of inquiry promises, leads me to urge the aid and co-operation of the profession in promoting one of the main objects of the “*Journal of Public Health*,” viz : to trace out “the connection between certain unhealthy conditions of the human family, and unhealthy conditions in inferior animals and plants.” An earnest desire that this object should be faithfully carried out, suggests the propriety of shortly indicating the

kind of facts which it is advisable to collect, as well as for the satisfaction of such as apply the *cui bono* test to every such inquiry, the kind of generalizations to which the classification of these facts is likely to lead. It would occupy too much space were I to do more here than merely skeletonize the subject. The heads of the inquiry will, however, suggest many of the details, for which I beg to refer to papers already published in other medical journals.¹

Never was the light of science so fully brought to bear on the investigation of disease ; never was the profession so fully equipped for such an inquiry ; never was the practitioner so ready, as well as able, to put his shoulder to the wheel, and do the trench work of the assault ; never was there a higher degree of cultivation of the observative faculties, than at the present moment. Let us then no longer tread the beaten, and now barren, paths of our predecessors ; let us enter upon a fresh subject of inquiry—a more promising, and comparatively unexplored field. Now is obviously the proper time to prepare ourselves for the investigation—to consider the subject in all its bearings. Let us not be lulled into apathy by present immunity ; let us not be found unprepared and in confusion when the epidemic again breaks forth. This would be but repeating the fatal errors of our predecessors. Only last spring, there were sporadic cases of cholera in different parts of Britain ; and, during the past year, it has not only been constant in the Crimean army, but has ravaged many parts of Southern Europe. The germs of the pestilence are evidently floating over Europe, and they only require a suitable nidus to take root and fructify. “Let us then be up and doing,” with “Semper paratus” for our motto, that, burst forth when it may, we shall be ready to grapple more successfully with the destroyer—to attack him with more powerful weapons than heretofore.

The inquiry branches out into so many different departments, that it is obviously impossible for individual practitioners, who have at their disposal only a limited amount of time and opportunities, to make and record observations or experiments on all the topics which I am about to mention. But it is in the power of the provincial practitioners of Britain to be of great service, not perhaps so much by personally observing facts, as by recording those observed by others. They might do great good, at a trifling expense of time or trouble, by directing to this subject the attention of non-professional persons, whose duties or tastes lead them constantly to observe the habits and diseases of the lower animals, especially such as are domesticated, and by recording the results of their experiences, whether positive or negative. To indicate the kinds or classes of persons to whom I here allude, I need merely mention dog-breakers, cattle-breeders, sheep-dealers, graziers, farmers, grooms, poultrymen, and the like. Such a record, like a register of meteorological observations, though

¹ *Association Medical Journal*, Dec. 15, and Sept. 15, 1854. *Gazette hebdomadaire de Méd. et de Chir.*, Nov. 24, 1854. *Edinburgh Medical and Surgical Journal*, April and Oct. 1854.

apparently uninteresting or unimportant in detail, could not fail to prove of the utmost value in the aggregate, whatever the nature of the general results or conclusions to which it pointed. For it must ever be borne in mind, that negative facts in science are often of equal importance with those which are positive—a knowledge of what is not, frequently most materially assisting us in arriving at a knowledge of what is. Let not an observer or recorder be prevented from giving publicity to a single fact on account of its apparent insignificance; in an investigation of such a nature, every well ascertained fact has its positive and relative value. While some facts are of such a kind that they may be, with propriety and safety, observed by non-professional, and even by totally uneducated persons, and may be accepted without further evidence than the testimony of an informant, others must be tested by experiment, and not a few ought to be sifted by scientific experts, acquainted with the details of modern histology, chemistry, and pathology, and conversant with all the bearings of the subject. I would suggest that particular points be selected for investigation, according to the opportunities or inclinations of individual members of associations or societies, whose researches might converge towards a common aim. Our medical societies, especially such as devote attention to the natural history of epidemics, might do much service to science by taking up this inquiry officially. Such a mode of following out the subject, is most likely to be followed by beneficial results.

From observations and experiments made in various parts of Central Europe, and to a less extent in India and Britain, it would appear that, coincident in date with cholera epidemics in man, there have frequently appeared cholera epizootics among the inferior, and especially the domesticated, animals; that this cholera in animals resembles that of man in its symptomatology and pathology; and that it is communicable, not only between different individuals, but between different species and genera, and also to and from man. Immediately after the first visitation of cholera to Europe, in 1832, several excellent reports appeared on the effects of the epidemic poison on the lower animals—the best which I have seen being that of the Faculty of Medicine at Vienna, relative to the epizootic in Lower Austria, Galicia, Moravia, and Bohemia.¹ The latter narrates that, while no animals were exempt from the influence of the “epidemic constitution of the atmosphere,” the disease most closely resembled human cholera in animals having similar structure and habits to man, such as the dog. The chief animals in which cholera has been noted to have occurred in Europe, are horses, cattle, dogs, cats, and poultry,—or, in other words, the domestic animals; while in India, and other foreign countries, in addition, racoons, camels, zebras, and monkeys have been mentioned. Records also mention a

¹ A most interesting abstract will be found in the *British and Foreign Medical Review*, January 1837.

number of other animals, but the evidence is not so conclusive, as I shall immediately show. Few additions have been made to our knowledge of the subject since 1832 ; but the scattered cases which are occasionally recorded, are of sufficient interest to show how much remains to be observed. A recent letter from Dr Furlong, Antigua,¹ states, that, during the prevalence of cholera at Trinidad, travellers, in passing through the woods, found the monkeys in large numbers dying and dead of the disease ; and he remarks, that domesticated or pet monkeys were equally affected. It is of interest to know, that the same animals in Trinidad were similarly affected by variola when it was epidemic. It has frequently been observed in this country, that, prior to or during epidemics of cholera, there have been extensive and sudden diseases in cultivated plants, such as the potato, and in domestic as well as wild animals, such as cattle, horses, sheep, rabbits and hares, poultry, game, crows, sparrows and other birds, and even fish. But there is no conclusive evidence that the disease was, in these cases, cholera. The coincidence in date would, however, point to something more than an accidental relationship. In many of the recorded cases of cholera in the lower animals, the arguments in favour of the choleroïd nature of the disease are far from conclusive or convincing ; in others they are only presumptive ; in very few is the proof satisfactory. Speculations, founded on appearances or resemblances, have been allowed to gain the ascendancy over rigid scientific demonstration—coincidences have been too much regarded as synonymous with effects of a common cause—the *post hoc* has been mistaken for the *propter hoc*. Observation and argument alike have been loose and unscientific : chemistry, histology, and pathology have seldom or never been employed as adjuncts to the inquiry. The deficiency of pathological examination, indeed, may be considered the most serious defect of all the cases of cholera in animals as yet published. The facts hitherto recorded would lead to the inference, that the cholera poison is equally deleterious to plants, the lower animals, and man, though it produces somewhat different effects in those different classes of organized beings. Such facts, however, from what I have already said, cannot be considered firmly established. It should be the object of future researches to corroborate or disprove them. So soon as it can be shown satisfactorily that epizootics during, or preceding, periods of epidemic cholera are, in their causation and nature, choleraic, a most important point is gained ; for then cholera becomes subject to scientific experimentation. The causation of epizootic diseases has frequently been referred to the fact of animals feeding on plants affected with epidemic disease. This merely refers us a step further back in the inquiry, whose features it does not otherwise alter ; it also indicates the necessity and importance of investigating, at the same time, and in the same manner, the epidemic diseases both of plants and animals, inasmuch as they are calculated to throw light on each other.

¹ *Lancet*, December 2, 1854.

As in human cholera, we must be prepared to investigate the etiology of the subject under two distinct heads: we must, on the one hand, examine the nature of the germ—the ferment—the aërial poison or miasm, of what nature soever, which is the immediate excitant of the disease; and, on the other, the nature of the soil or nidus in which alone this germ will develop itself—the predisposition, without which the poison is inoperative. As in human cholera, also, we are more likely to arrive at satisfactory results regarding the predisposition than the exciting cause—the suitable soil, rather than the poison germ itself. But, without a thorough knowledge of the subject of predisposition, the investigation of the essential nature and *modus operandi* of the cholera poison cannot be properly undertaken. The artificial creation of a predisposition to contagious diseases, I hold to be one of the chief elements of success in experimentation on the transmissibility of cholera to animals. The chief features of the laws of the diffusion of epidemic cholera in man must also be borne in mind: for instance, its unequal and partial distribution—its attacking places characterized by certain conditions of temperature, moisture, drainage, etc.—its varying duration—its course, in opposition to ordinary physical laws, etc.

We are not to look, in epizootic cholera, for all the symptoms of human cholera, as laid down in systematic treatises or textbooks. Even in man, the conventional symptoms are frequently absent; and the only one which can be said to be invariable, and hence essential, is collapse. In proportion as cholera is becoming domesticated among us, so do we find its types and symptoms undergoing modification; and, if such be the case in man, how much less should we expect to find the same symptoms in animals differing essentially from him in structure, habits, and food? In proportion, however, as an animal resembles man in the structure of its digestive apparatus, in the nature of its food, and in its habits, so shall we expect to find the characters of the disease resembling those in the human subject. Thus we shall find the dog—man's most constant companion—one of the best subjects in which to study the cholera of the lower animals. The symptomatology of epizootic diseases is somewhat puzzling, and liable to lead into error. For instance, cases of sudden death are common in cattle and other ruminants, proceeding from acute intestinal lesions; while many symptoms, resembling isolated or individual symptoms of cholera in man, such as cramps, vomiting, thirst, and diarrhoea, are very common as symptomatic of mild affections in some of the lower animals, such as the dog. The absence and presence of particular symptoms are thus alike delusive; hence, nothing can atone for a deficiency in accurate observation, especially in pathological examination. The subject of cholera in the lower animals cannot be perfectly understood without a knowledge of other epizootic diseases; while, again, for the satisfactory investigation of the latter, a familiarity with the ordinary sporadic diseases to which the lower animals, domesticated and wild,

are subject, is necessary. The study of epizootic cholera by medical practitioners would probably give a stimulus to the study of veterinary medicine, and lead especially to a greater cultivation of veterinary pathology, some departments of which bear specially on our present subject. Among other points in the pathology of epizootic diseases which appear to demand greater elucidation in reference to cholera or choleroïd affections, is the pathology of the gastro-intestinal mucous membrane, along with its morbid secretions or discharges, with a view to the establishment of a differential diagnosis between cholera and allied diseases.

The chief classes of cases to which the attention of observers should be directed are :—

I. Epizootic diseases occurring during periods of immunity from epidemic cholera in man, preceded, or not, by sudden and extensive disease in cultivated plants, such as the potato, vine, and cereals, and which are either marked by choleraic symptoms, or by sudden deaths, without any symptoms.

II. Epizootic or sporadic diseases coincident with epidemic cholera in man, and marked by similar symptoms, or by sudden deaths.

III. Seizures in certain domestic animals—especially dogs and cats—after licking the evacuations, or inhaling the effluvia of the clothing or bodies, of living or dead human cholera patients, or which have been exposed to other known sources of infection.

The latter class of cases is invested with peculiar interest, and they ought to be carefully sought for and observed. A few cases are on record of dogs, which have accidentally swallowed the cholera evacuations of their masters or mistresses, being seized with and dying of cholera; and it has also been stated, that animals thus affected have communicated the disease to man, in whom it has proved fatal.¹ Here, then, we have instances of the double transmissibility of cholera, viz. :—to and from man and the lower animals. But, in a question of such importance, it is necessary that the facts be repeatedly confirmed before they can be received as established and undeniable. In the examination of such cases, it is of great importance to determine whether the apparent cause of the disease was the swallowing of the evacuations, or the inhalation of the poison, or both—whether, in other words, the intestinal or the cutaneous and pulmonary systems were the first recipients of the poison. It is almost unnecessary to point out the bearing which the decision of such a question has upon the theory recently advanced by Dr Snow and others—viz., that the germs of the disease are received directly into the alimentary canal, and there produce their poisonous effects. It is, moreover, advisable to note the precise period after discharge at which the evacuations were swallowed, since recent authors maintain that these are poisonous, and can communicate the disease, only at particular stages of decomposition. In connection with this point, the experiments of Thiersch, on the Continent, may be remembered :

¹ Some such instances will be found in a valuable paper of Mr Marshall's on the communicability of cholera to animals. *British and Foreign Medico-Chirurgical Review*, April 1853.

he found that mice were seized with fatal cholera on swallowing evacuations only on the lapse of a certain period after evacuation.¹ Some experimentalists hold that the cholera poison resides in the fixed, others in the volatile, products of decomposition of the evacuations; while some regard these dejections as wholly innocuous. This contrariety of opinion—this opposing testimony of experimentalists—is only one instance of the necessity of endeavouring to decide the question by observation on cholera among the lower animals. It may also be here mentioned, that there are recorded cases of men having accidentally or intentionally swallowed large or small quantities of the evacuations of cholera patients without subsequent bad effects; they are, however, of comparatively little value.

The primary heads of inquiry are the following:—

I. Is cholera essentially human; or is it common to the lower animals along with man?

II. Is it contagious among the lower animals?

III. Is it transmissible to and from man, and between different species and genera of the lower animals?

IV. Is it preventible and curable among those animals?

The chief questions with which we start the inquiry will probably be:—

I. Are sporadic and epizootic diseases of the lower animals, which have been observed prior to, during, or immediately subsequent to, epidemic cholera in man, not equally common at other periods, when there is no presumptive evidence of any cholera poison existing in the atmosphere? If so, wherein do they differ from, or resemble, the same diseases occurring during the prevalence of cholera in man.

II. What is the precise connection between coincident epidemics in plants, the lower animals, and man, in regard to causation? Is it merely coincidental, or are they really due to a common cause? And, if so, what are the laws which regulate the influence of the same atmospheric poison on these different classes of organized beings?

In regard to *Etiology*, many most important questions arise. But here it is specially necessary to be cautious in accepting facts, that are not thoroughly established, as the basis of theory; for there has been more loose reasoning, more speculative argumentation, without adequate data, on the nature of the cause of cholera, than on any other branch of its natural history. Among etiological problems, I would propound the following:—

I. Do *known* chemical poisons—atmospheric, or otherwise—produce the same effects on animal life as the *unknown* cholera poison? Under this head, it is advisable to learn the influence on the lower animals of the poisonous emanations from chemical manufactories, putrid organic matter, and similar atmospheric contaminations, whose effects on man and on vegetation can be taken as a standard.

II. Origin and mode of diffusion of epizootic cholera: wherein it resembles or differs from the diffusion of cholera in man.

¹ *Medical Times and Gazette*, November 18 and 25, 1854.

III. Contagiousness or transmissibility of the disease, whether sporadic or epizootic.

- a. Circumstances essential or accessory—favourable or unfavourable—thereto, or the laws whereby it is regulated.
- b. Is it transmissible not only between different individuals of the lower animals, but between different species and genera, as has been frequently observed in different parts of Central Europe? What are these species and genera; and under what circumstances does the transmission of the disease occur?
- c. Is it transmissible from different species and genera of the lower animals to man, or from him to them; and, if so, by and between what species or genera, and under what circumstances?

As bearing on this point, it will be advisable to keep in mind, on the one hand, other diseases which are communicated from the lower animals to man—such as glanders from the horse—hydrophobia from the dog—scabies from the lion;—and, on the other, cases mentioned by various experimenters and observers of cholera being transmitted from man to the dog. This is a problem of special interest, which only an array of well established facts can satisfactorily solve. Hitherto, the mere idea, that human diseases can be communicated to the inferior animals, has met with general opposition; but the point appears never to have been carefully investigated.

- d. Comparative toxic action of the effluvia from the skin and lungs, and of the evacuations.

Here it may be borne in mind that, in other diseases of the lower animals, as of the dog, the effluvia from the skin are highly poisonous, constituting the media of contagion.

- e. Comparative frequency of the seizure from contact with diseased animals of the same or different species or genera, and with man.
- f. Effects of inoculation on veterinary surgeons, butchers, and others, or the results of wounds received while dissecting or operating on the bodies of animals dying or dead of cholera or choleroïd diseases.
- g. Comparative immunity of persons constantly in contact with diseased animals, as grooms, dog-breakers, veterinary surgeons: the general or special effects on their health.

IV. Is the poison solely aerial; to what height does it pervade the atmosphere; and is it most concentrated and most deadly in the stratum of air immediately resting on the earth's surface? What bearing on these points have the following circumstances?

- a. The seizure of fish and crustaceans.
- b. The great susceptibility of birds to be affected by cholera.
- c. The frequent absence of swallows, and other migratory birds, from tainted districts.

It is important to note the relation of the diffusion of cholera to the geographical distribution of animal species and genera.

V. Liability of animals labouring under other diseases to be affected by, or exempt from, the cholera poison. Co-existence of cholera with other, and what other, diseases; how far immunity produced, or the milder disease modified, by the presence of the graver one?

VI. Predisposition.

- a. Effects of domesticity or civilization—one of the most powerful predisposing causes of disease in the lower animals.

1. Food—excessive quantity or improper quality. Habitual excess of vegetable food is a powerful predisposing cause of intestinal diseases; hence the great susceptibility of ruminants to be affected with lesions of the gastro-intestinal system, and to

sudden deaths proceeding from, or connected with, acute intestinal inflammations.

2. Deficiency of exercise, especially in proportion to the nature of their food—as in the horse and dog.
3. Oehlesis, or over-crowding, in badly ventilated and lighted, overheated, damp, byres, stables, and kennels, often situated in the centre of large cities, and surrounded by the worst sanative influences.
- b. Peculiarities of structure, constitution, and habits—as the structure of the alimentary canal in ruminants, and the frequency of vomiting in the dog and cat.
- c. Influence of meteorological conditions or changes.
 1. State of motion or rest of the atmosphere.
 2. Hygrometric state of atmosphere.
 3. Electrical state.
 4. Temperature.
 5. Weight of atmosphere, as shown by barometrie pressure.
 6. Oxidizing power, as shown by action on ozone test-papers.
 7. Presenec of the products of decomposed animal and vegetable matter—gaseous or solid—such as gaseous contaminations of malarious origin.
 8. Presenec of animal and vegetable organisms—such as animal-cules and fungoid sporules.

Meteorological conditions cannot be said hitherto to have thrown much light on the etiology of cholera, no change evident to the senses being generally detected in the atmosphere of cholera districts or during cholera epidemics. But it is advisable to remember that the air has been found denser, more moist, warm, and stagnant during periods of cholera; that it has shown no action on ozone test-paper; that, in the atmosphere of cholera wards, the microscope has detected vibrios, sporules of fungi, and various disintegrated elements of animal and vegetable tissues, besides mineral debris;¹ and that gaseous poisons, which are known to be deleterious to animal and vegetable life, have likewise been detected. But there is insufficient evidence that any of these conditions are peculiar to periods of cholera epidemics; indeed, it is probable that they have not been found equally common during the prevalence of other diseases, in great measure, because they have not been looked for with equal care.

- d. Geological structure and physical configuration of the locality.

The universality of the diffusion of cholera would tend to indicate that its progress is independent of the nature of the soil, of climate, temperature, season, and other ordinary influencing causes of disease; but, on the small scale, it would appear that its course is sometimes regulated in a marked degree by the character of the soil—for instance, by diluvial soil.²

- e. Influence of prolonged exposure to a cholera atmosphere.

Does a weakened condition, or limited amount of the cholera poison,

¹ "Chemical Conditions of Cholera Atmospheres," by Dr R. Dundas Thomson. *Lancet*, Jan. 19, 1856.

² M. Boubée, Communications Relative to Cholera, and, among others, to the Geological Course of Cholera. "Académie des Sciences," Paris, October 2, 1854.

produce specific, or non-specific, or any effects, in the lower animals?

The following important questions also suggest themselves for solution under the head of the *symptomatology* of epizootic cholera :—

- I. What are the types or phases of cholera in different species and genera of animals, and in different individuals of the same species, under different circumstances of climate, country, and other causes of predisposition?
This involves an explanation of the circumstance, that different animals have been noticed to be affected in different places; for instance, dogs in one district or country, horses in another, cattle in a third, and birds in a fourth.
- II. *a.* Modifications in the type, phases, or symptoms, produced from year to year, and in proportion as the disease becomes more frequent.
b. Modifications produced by transmission through different animals or through different species and genera, particularly by transmission to or from man.
c. Modifications produced by pre-existing or co-existent disease, by age, sex, etc.
- III. What are the essential, and what the accessory or incidental, symptoms? How far are these liable to modifications by the above causes?
- IV. Comparative frequency of the disease in domesticated and wild animals; and in what respects does the disease in the one class resemble, or differ from, that in the other?
- V. Prevalence of a specific or non-specific premonitory diarrhœa. Comparative frequency of prodromata and sudden attacks.
- VI. Spontaneous tendency to recovery, and its forms at various stages of the disease.
- VII. Mortality at different stages.
- VIII. Period of incubation of the poison.
- IX. Recurrence of the disease in the same individual.
X. Comparative frequency of cases marked by mucoid discharges and other conventional symptoms of cholera, and of sudden deaths resulting from the primary shock on the nervous system.
- XI. Relation of special symptoms, such as vomiting, cramps, collapse, and thirst, to cholera, or to diseases marked by intestinal lesions. Relation of special symptoms, such as the character and amount of the intestinal discharges, to the intensity or type of the disease.
- XII. Differential diagnosis between diarrhoid, dysenteroid, and choleroïd diseases.
- XIII. Connection of symptoms of what is generally denominated the fever stage of cholera with renal affections.
- XIV. Does cholera in animals appear to be an affection *sui generis*; has it the characters of a fever, resembling those of malarious type and origin; or to what class of affections does its symptomatology appear to refer it?

I have already said enough to indicate the importance, nay, the paramount necessity, of making a *pathological examination* in every case. In addition to the ordinary *post-mortem* investigation, a microscopical and chemical examination should be made, where opportunity occurs, of the various secretions and excretions, and of the abdominal viscera. The condition of the mucous membrane and contents of the intestines is, of course, of primary importance. In this investigation, it is necessary to beware of confounding causes

and effects, as has been too frequently the case in the history of the pathology of human cholera, especially in regard to the biliary and renal secretions, the blood, and the epithelial lining of various mucous membranes. According to my own experience, in dogs which died of cholera, produced in the course of experimentation, the pathological appearances resembled those of human cholera chiefly in the following points:—

1. Hyperæmia, ecchymoses, or hæmorrhagic oozing or exudation, of or in the intestines.
2. Enlarged or prominent solitary and Peyerian glands.
3. Presence of icky mucus in the canal.
4. Thickened, sodden condition of the mucous membrane.
5. Gluey exudation on external or peritoneal surface of intestines.
6. Discoloration of lower portions of gut, as in dysentery.
7. Mammillation of the interior of the stomach.
8. Healthy bile.
9. Healthy blood.
10. Biliary reaction of the urine.
11. Dryness of the muscles and viscera.¹

By means of experimentation, valuable lessons might be learned on the *treatment* of the disease; but I shall only propound the general heads of this branch of the subject.

- I. Influence of prophylactic measures in preventing the development and subsequent spread of the disease. What are the best prophylactics in all or special cases?
- II. Influence of the empiric use of medicines, or of a rational mode of treatment, in curing the disease after it has been fully developed. What kind of medicine, or what line of treatment, is most successful, if any?

Here the distinction must be carefully drawn between the actions of medicines, the results of curative treatment, and the spontaneous tendency of the disease towards recovery.

An appropriate supplement to remarks on the natural influence of cholera on the lower animals, is the subject of *experimentation on the communicability of the disease* to these animals; a subject which, like the former, though of great importance as bearing on the natural history of cholera in man, has attracted comparatively little attention in this country. On this subject, however, my space forbids me to enter. Nor can I do more than merely allude to the influence of the atmospheric poison, during periods of epidemic cholera in man, on vegetation—to the *epidemic diseases of plants*, a subject to which many of the above remarks equally apply. The study of the epidemic diseases of plants ought to rank *pari passu* with that of epizootic diseases in the lower animals; these diseases are probably intimately connected, and a knowledge of the one class is calculated to throw light on the study of the other.

¹ *Association Medical Journal*, "Clinical Notes on Cholera," Sept. 15, 1854.

I shall have pleasure in becoming the recipient of any communications bearing upon topics or points discussed or alluded to in the course of the preceding remarks.

